

## 299-W14-19 (C3957) Log Data Report

### Borehole Information:

<b>Borehole:</b> 299-W14-19 (C3957)		<b>Site:</b> East of TX Farm			
<b>Coordinates</b> (WA State Plane)		<b>GWL (ft)<sup>1</sup>:</b> 224.0	<b>GWL Date:</b> 10/19/2002		
<b>North</b>	<b>East</b>	<b>Drill Date</b>	<b>TOC<sup>2</sup> Elevation</b>	<b>Total Depth (ft)</b>	<b>Type</b>
Unknown	Unknown	Oct. 2002	Unknown	344	Becker

### Casing Information:

Casing Type	Stickup (ft)	Outer Diameter (in.)	Inside Diameter (in.)	Thickness (in.)	Top (ft)	Bottom (ft)
Threaded Steel	0.83	11.75	10.75	0.50	+0.83	30.0
Threaded Steel	2.41	9.00	8.00	0.50	+2.41	344.0
Threaded Steel	2.83	6.25	6.00	0.125	+2.83	344.0
The driller was the source for the casing depth and stickup information.						

### Borehole Notes:

Well construction information, as shown in the above tables, is from measurements by the driller and Stoller personnel. The wellsite geologist supplied the depth to groundwater. Zero reference is the ground surface. The logging engineer measured the outside and inside casing diameters of the 6-in. and 11-in. casings using a steel tape and calipers. The outside diameter of the 9-in. casing was measured with calipers and a steel tape. The inside casing diameter of the 9-in. casing was estimated. The Becker drilling system utilizes a special dual-wall casing string. Air passes through the annular space between the inner and outer casings, and rill cuttings are brought up inside the inner casing. For this well, the casing consisted of a 6-in. ID inner casing with 0.125-in. wall thickness inside an 8-in. ID outer casing with 0.5-in. wall thickness. The inner casing is thicker at casing joints, where wall thickness is 0.406-in. Casing joints are approximately 1 ft long overall and occur at 10-ft intervals. No contamination was detected during drilling.

### Logging Equipment Information:

<b>Logging System:</b>	Gamma 3E (RLS-1)	<b>Type:</b>	70% HPGe
<b>Calibration Date:</b>	10/2002	<b>Calibration Reference:</b>	GJO-2002-386-TAR
		<b>Logging Procedure:</b>	MAC-HGLP 1.6.5, Rev. 0

### Spectral Gamma Logging System (SGLS) Log Run Information:

Log Run	1	2	3	4	5
Date	10/29/02	10/30/02			
Logging Engineer	Pearson	Pearson			
Start Depth (ft)	0.0	345.0			
Finish Depth (ft)	160.0	126.0			
Count Time (sec)	100	100			
Live/Real	R	R			

Log Run	1	2	3	4	5
Shield (Y/N)	None	None			
MSA Interval (ft)	1.0	1.0			
ft/min	N/A <sup>3</sup>	N/A			
Pre-Verification	CE021CAB	CE031CAB			
Start File	CE021000	CE031000			
Finish File	CE021160	CE031219			
Post-Verification	CE021CAA	CE031CAA			
Depth Return Error (in)	-0.5	0.0			
Comments	No fine gain adjustments.	No fine gain adjustments.			

### **Logging Operation Notes:**

Zero reference was the ground surface, and the borehole was logged through drill pipe. Logging was performed with a centralizer installed on the sonde. Pre- and post-survey verification measurements for the RLS employed the Amersham KUT (<sup>40</sup>K, <sup>238</sup>U, and <sup>232</sup>Th) verifier with serial number 118. The interval from 160 to 126 ft is a repeat section that was acquired at the end of logging run two.

### **Analysis Notes:**

<b>Analyst:</b>	Sobczyk	<b>Date:</b>	11/04/02	<b>Reference:</b>	GJO-HGLP 1.6.3, Rev. 0
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RLS pre-run and post-run verification spectra were collected at the beginning and end of each day. The verification spectra were all within the control limits except for files CE021CAB and CE031CAB. These verification spectra were slightly above the control limit for the 609-keV full-width at half-maximum values. File CE031CAB was also above the control limit for the 1461-keV full-width at half-maximum value. The peak counts per second (cps) at the 609-keV, 1461-keV, and 2615-keV photopeaks on the post-run verification spectra as compared to the pre-run verification spectra for each day were stable and between 1 and 3 percent of one another. Examinations of spectra indicate that the detector appears to have functioned normally during all of the logging runs, and the spectra are provisionally accepted, subject to further review and analysis.

Log spectra for the RLS were processed in batch mode using APTEC SUPERVISOR to identify individual energy peaks and determine count rates. Post-run verification spectra were used to determine the energy and resolution calibration for processing the data using APTEC SUPERVISOR. Concentrations were calculated in EXCEL (source file: RLS-1Oct02.xls), using parameters determined from recent calibration data analysis results. Zero reference was the ground surface. Data were analyzed using a uniform casing correction based on the cumulative wall thickness of 0.625 in. for the dual wall casings. This correction was applied from 29.0 to 345.0 ft. From ground surface to 29.0 ft, the casing correction factor was calculated based on 1.125 in., which represents the cumulative thickness of the dual wall casings and the 10.75-in. ID surface casing. The increase in casing thickness at the joints in the dual wall casing results in an apparent reduction in concentration, because the actual thickness increases to 0.9 in., but the casing correction is not changed. A water correction was applied to the RLS data at and below 224.0 ft. For the 70% HPGe detector, dead time at background count rates varies from 2 to 6 percent, averaging about 4 percent. This variation appears to be the result of random fluctuation, because it does not correlate with count rate. This fluctuation is apparently an operational characteristic of the detector. Experiments with the detector in the calibration models indicate that the dead time is a function of count rate and that a dead time correction function similar to that developed for the SGLS can be used to linearize the data. Dead time values less than 10 percent should be ignored. Dead time corrections are required when dead time exceeds 18 percent. Because the dead time did not exceed 18 percent, a dead time correction was not needed or applied.

## **Log Plot Notes:**

Separate log plots are provided for gross gamma and dead time, naturally occurring radionuclides ( $^{40}\text{K}$ ,  $^{238}\text{U}$ , and  $^{232}\text{Th}$ ), and man-made radionuclides. Plots of the repeat logs versus the original logs are included. For each radionuclide, the energy value of the spectral peak used for quantification is indicated. Unless otherwise noted, all radionuclides are plotted in picocuries per gram (pCi/g). The open circles indicate the minimum detectable level (MDL) for each radionuclide. Error bars on each plot represent error associated with counting statistics only and do not include errors associated with the inverse efficiency function, dead time correction, or casing correction. These errors are discussed in the calibration report. A combination plot is also included to facilitate correlation. The  $^{214}\text{Bi}$  peak at 1764 keV was used to determine the naturally occurring  $^{238}\text{U}$  concentrations on the combination plot rather than the  $^{214}\text{Bi}$  peak at 609 keV because it exhibited slightly higher net counts per second.

## **Results and Interpretations:**

$^{137}\text{Cs}$  was the only man-made radionuclide detected in this borehole.  $^{137}\text{Cs}$  was detected only at 4.0 ft. The apparent activity was 1.0 pCi/g.

Recognizable changes in the KUT and total gamma logs occurred in this borehole. Below 33 ft, decreases in total gamma and KUT concentrations occur every 10.0 ft at the casing joints in the dual wall casing. These changes are due to an increase in gamma attenuation associated with the increase in casing thickness at the joints, rather than an actual change in activity, and are most apparent on the total gamma and  $^{40}\text{K}$  (1461-keV) logs. The relatively low concentrations of  $^{40}\text{K}$  above 30 ft are due to the surface casing. At 37 ft, there is a 5-pCi/g increase in  $^{40}\text{K}$  concentration and a 0.4-pCi/g increase in  $^{232}\text{Th}$  concentration. These increases in apparent  $^{40}\text{K}$  and  $^{232}\text{Th}$  concentrations may correspond with the depth of the Hanford H2. Between 97 and 104 ft, the fine-grained member of the Cold Creek Unit (formerly known as the Early Palouse Soil) is shown by an increase in total gamma (40 cps) and  $^{232}\text{Th}$  (0.5 pCi/g). At 104 ft,  $^{40}\text{K}$  concentrations decrease 10 pCi/g and  $^{232}\text{Th}$  concentrations decrease 0.7 pCi/g.  $^{238}\text{U}$  concentrations increase by approximately 1.0 pCi/g in the intervals between 107 and 110 ft and 117 and 119 ft. On the basis of low  $^{40}\text{K}$  and  $^{232}\text{Th}$  concentrations and relatively high  $^{238}\text{U}$  concentration, the carbonate-rich paleosols of the Cold Creek Unit are interpreted as being between 104 and 119 ft.

The plots of the repeat logs demonstrate good repeatability of the RLS data for the natural radionuclides at energy levels of 609, 1461, 1764, and 2614 keV.

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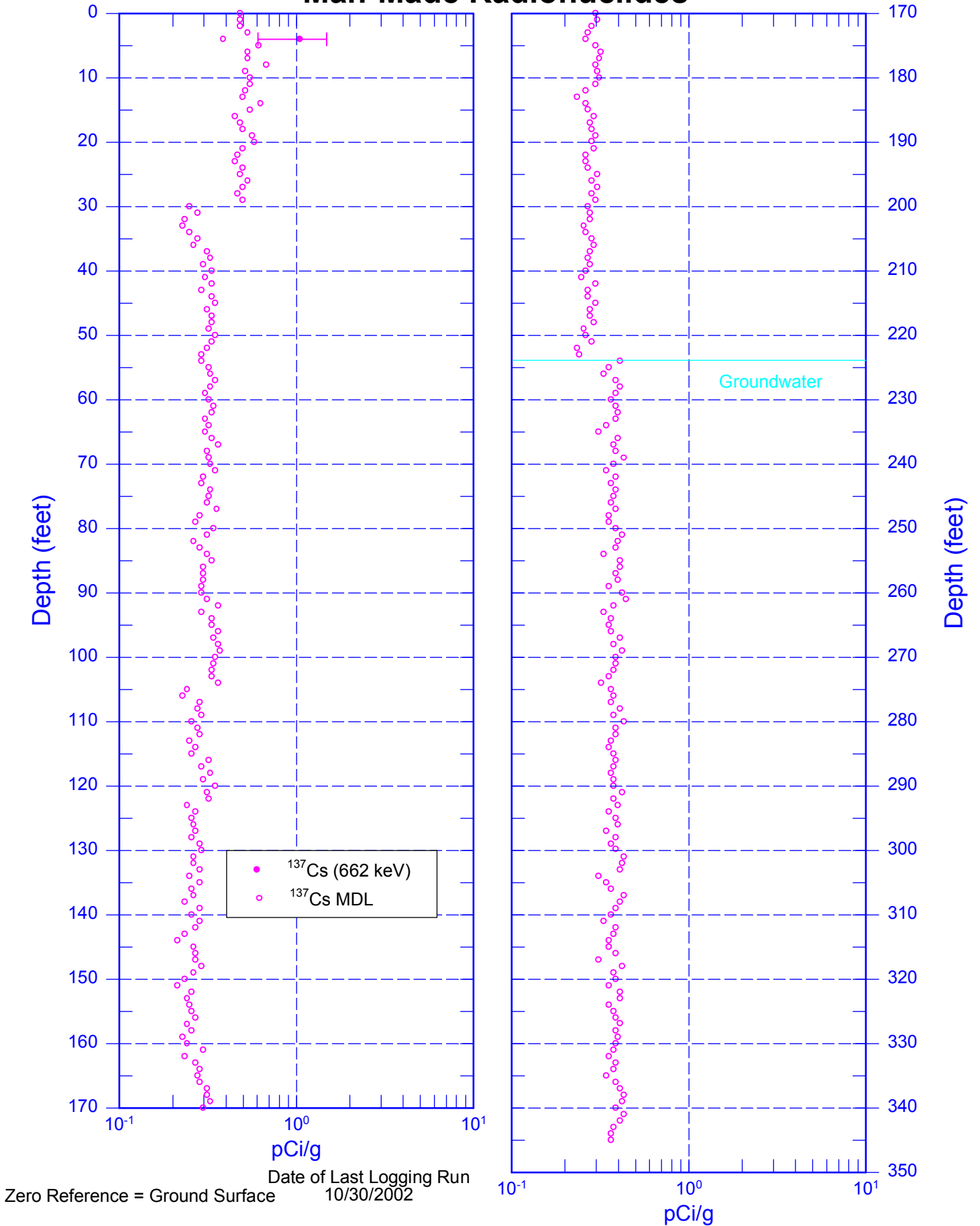
<sup>1</sup> GWL – groundwater level

<sup>2</sup> TOC – top of casing

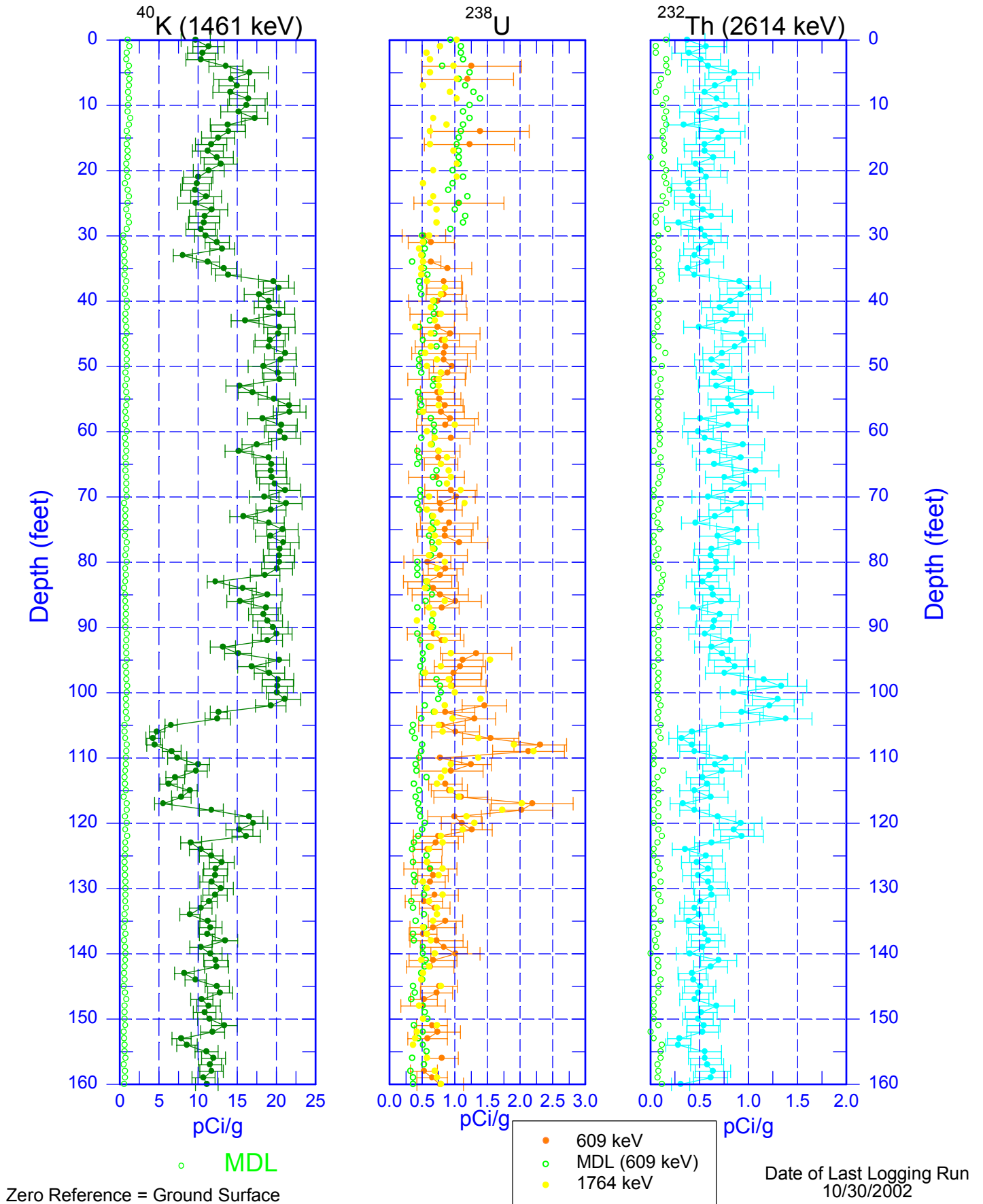
<sup>3</sup> N/A – not applicable

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## Man-Made Radionuclides

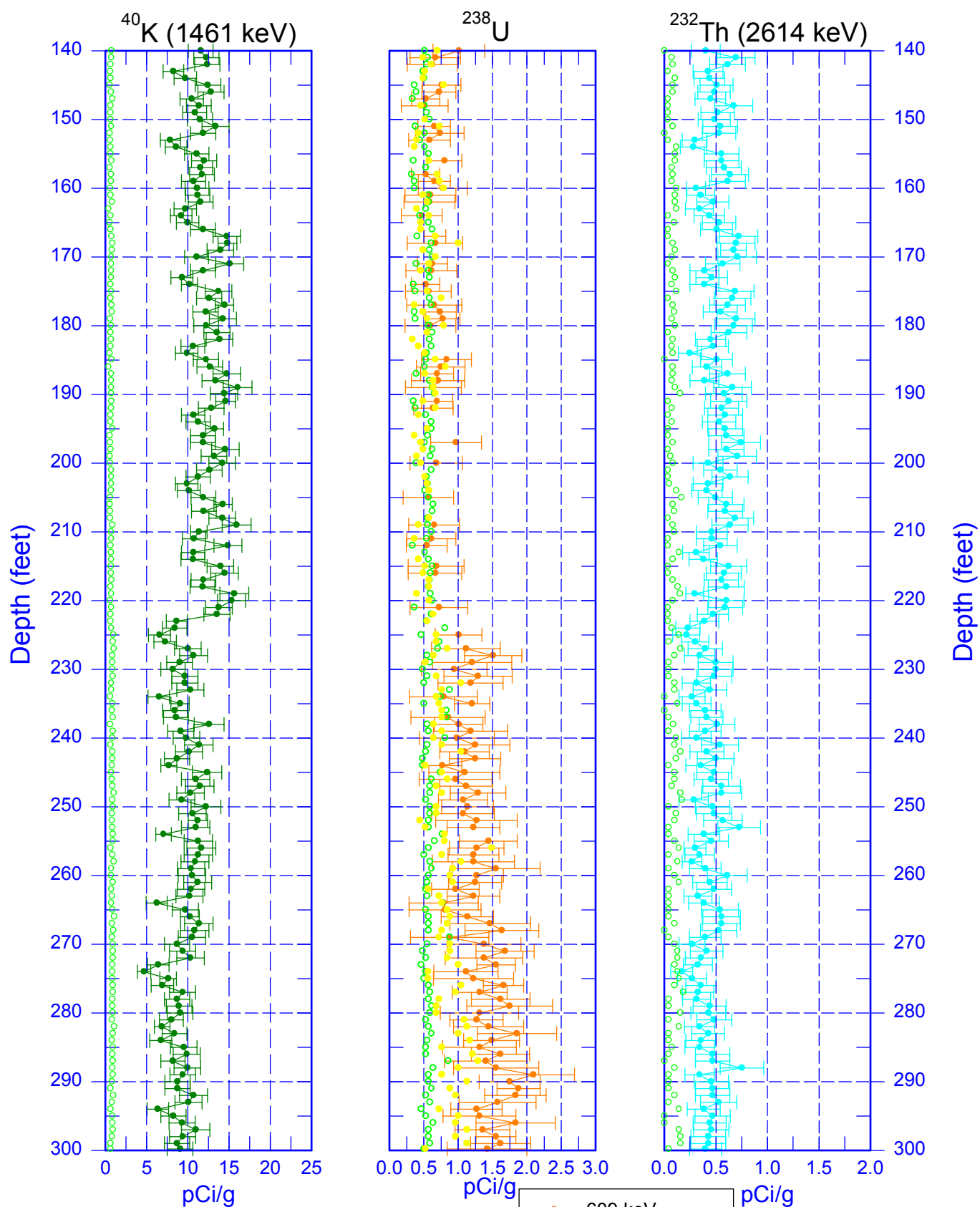


# 299-W14-19 (C3957) Natural Gamma Logs



# 299-W14-19 (C3957)

## Natural Gamma Logs



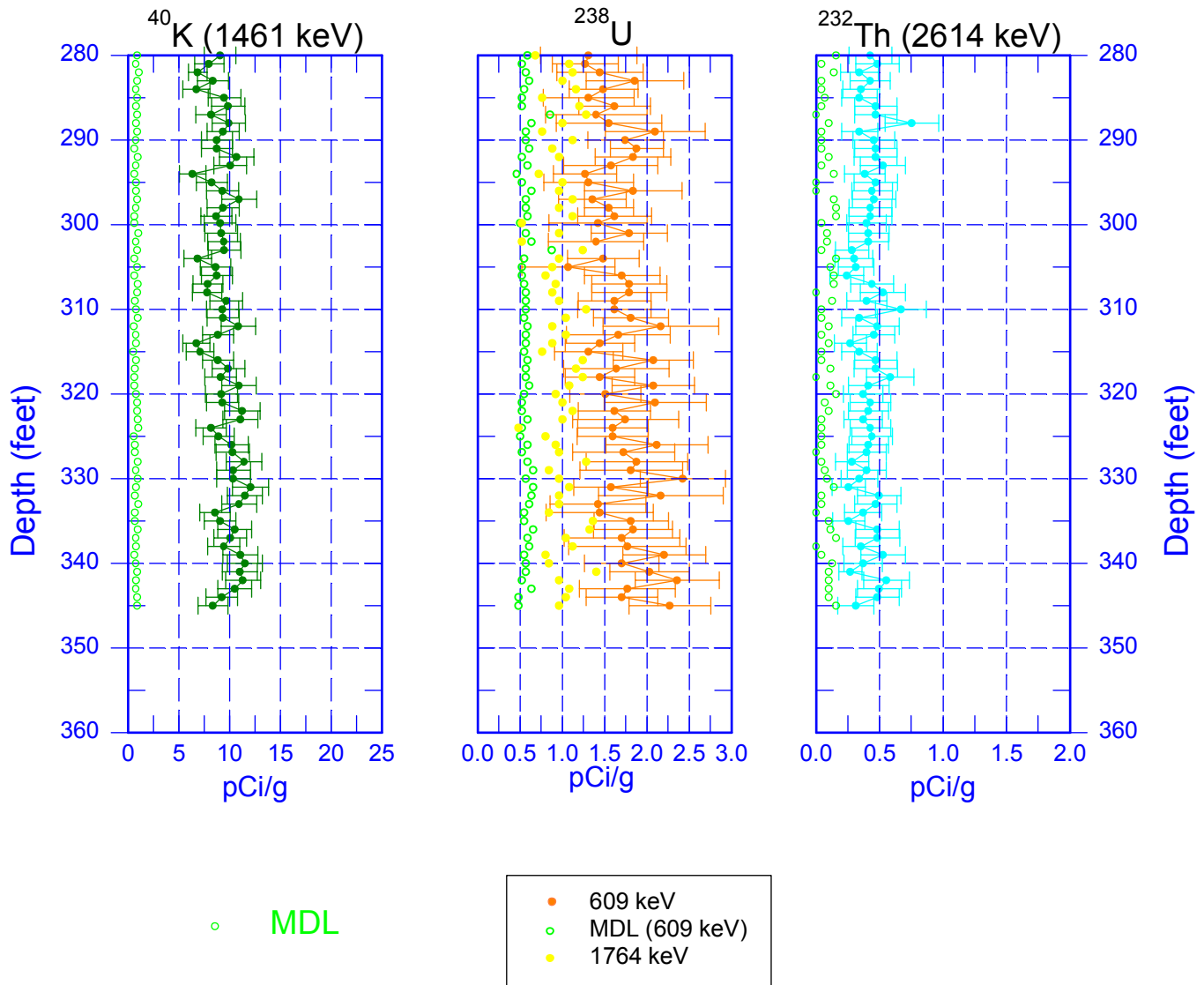
○ MDL

- 609 keV
- MDL (609 keV)
- 1764 keV

Zero Reference = Ground Surface

Date of Last Logging Run  
10/30/2002

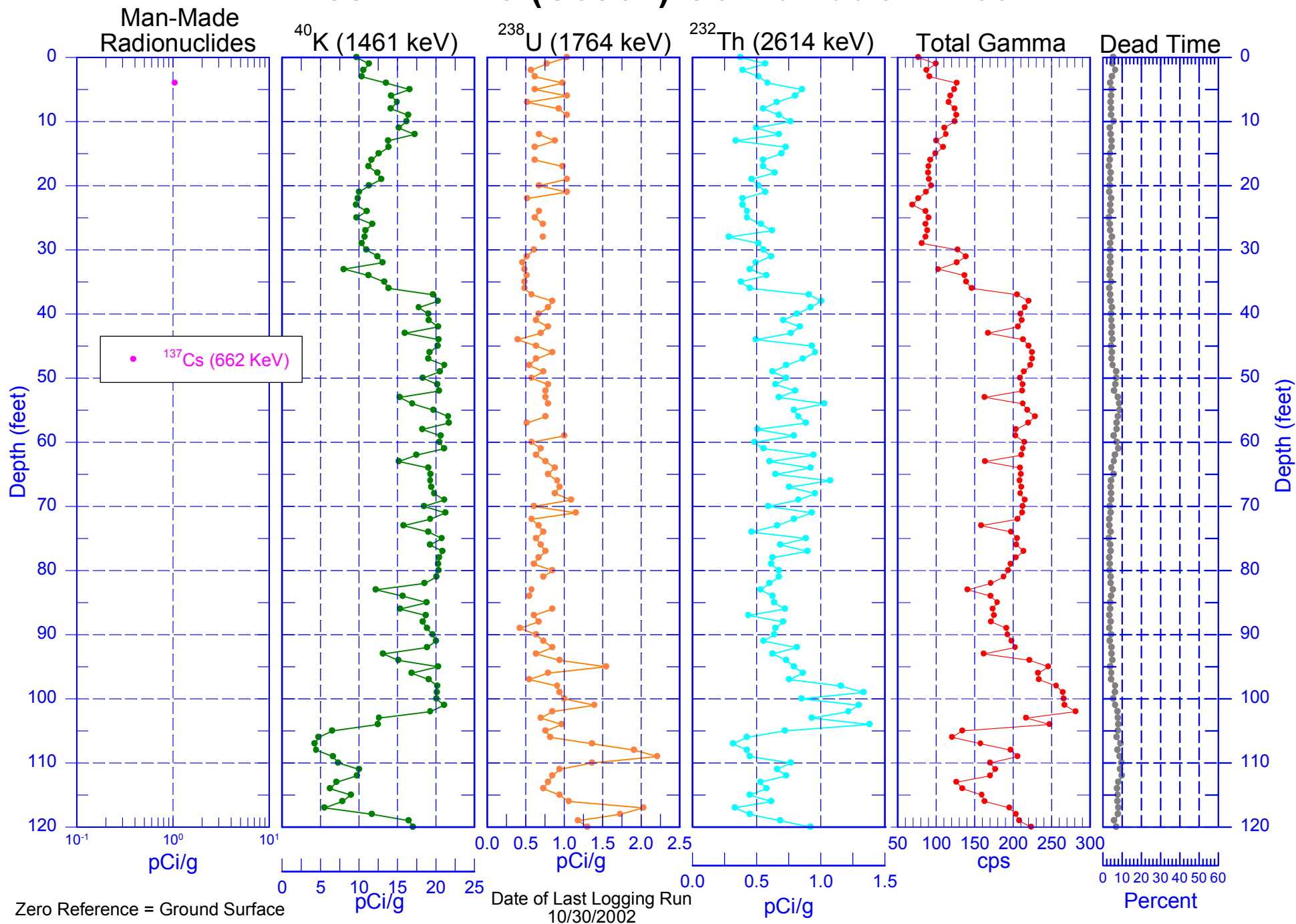
# 299-W14-19 (C3957) Natural Gamma Logs



Zero Reference = Ground Surface

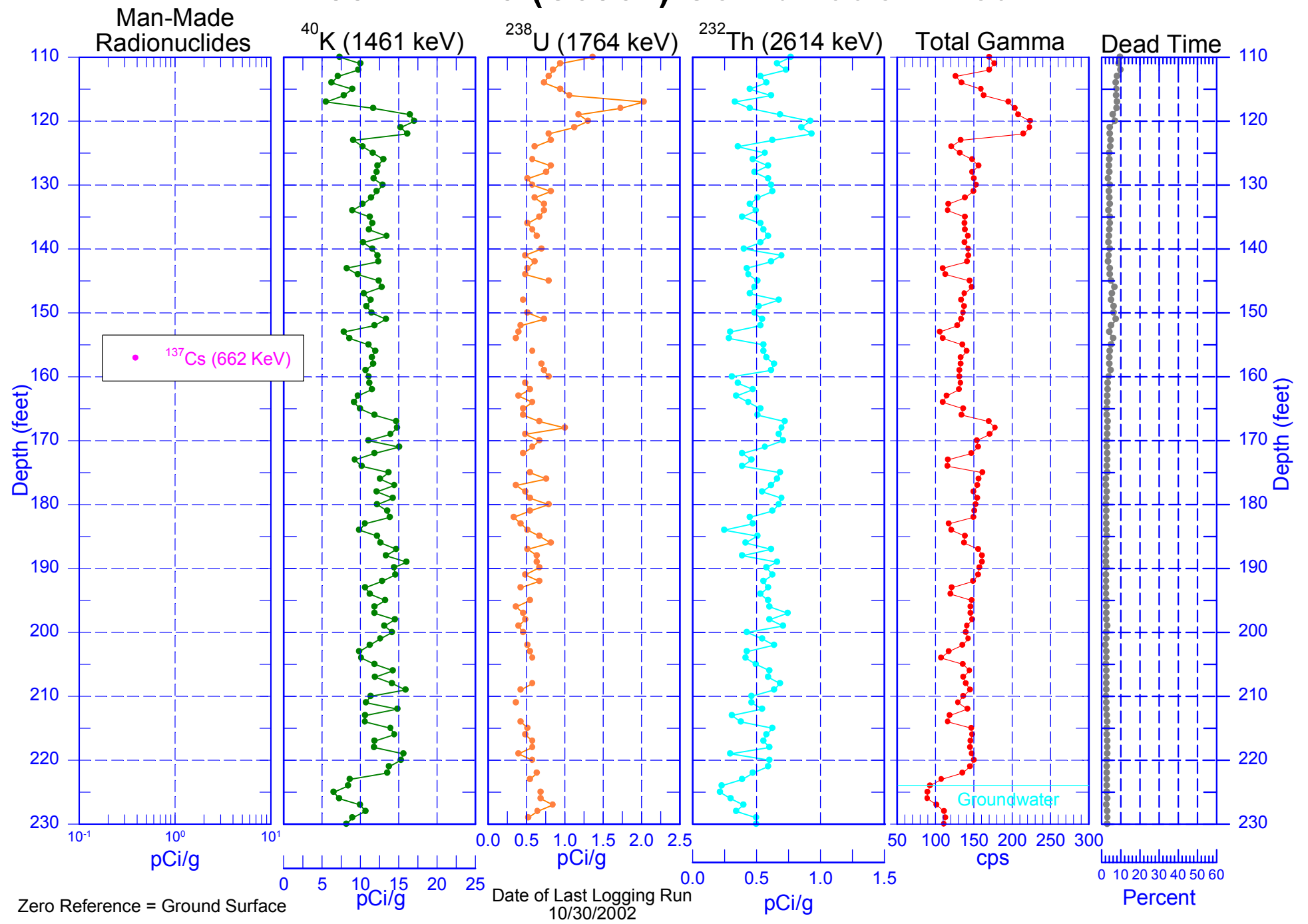
Date of Last Logging Run  
10/30/2002

# 299-W14-19 (C3957) Combination Plot

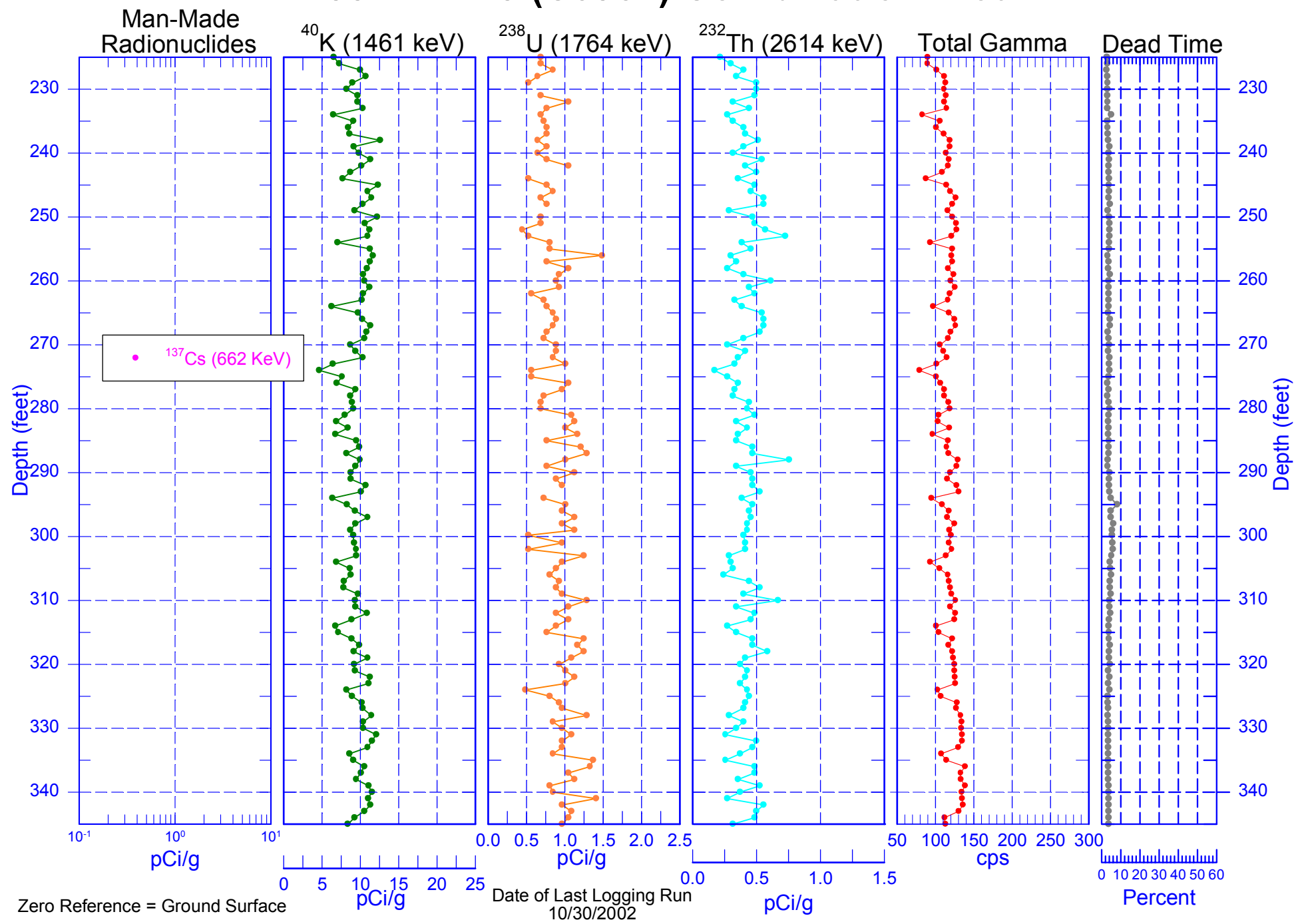




# 299-W14-19 (C3957) Combination Plot

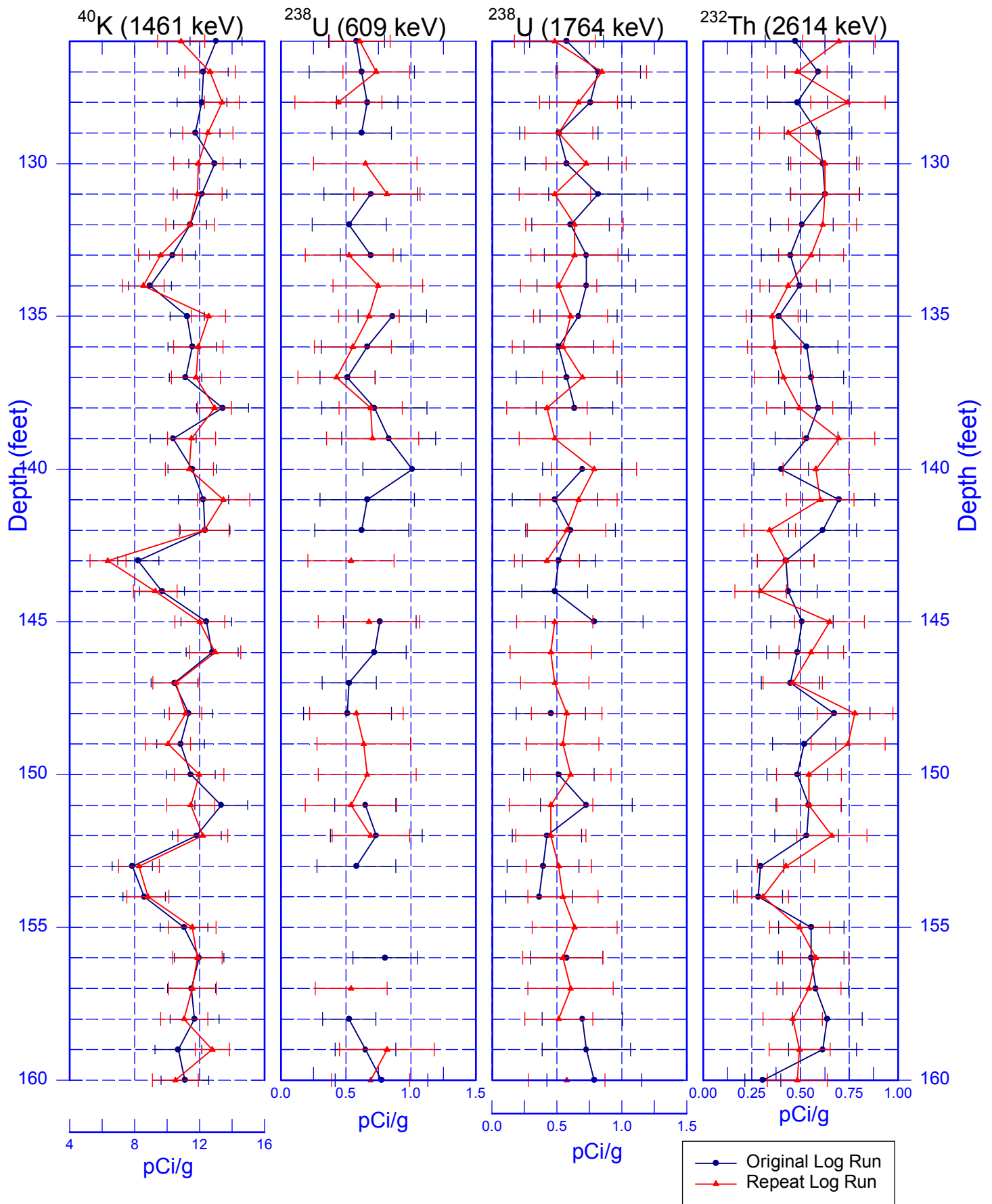


# 299-W14-19 (C3957) Combination Plot



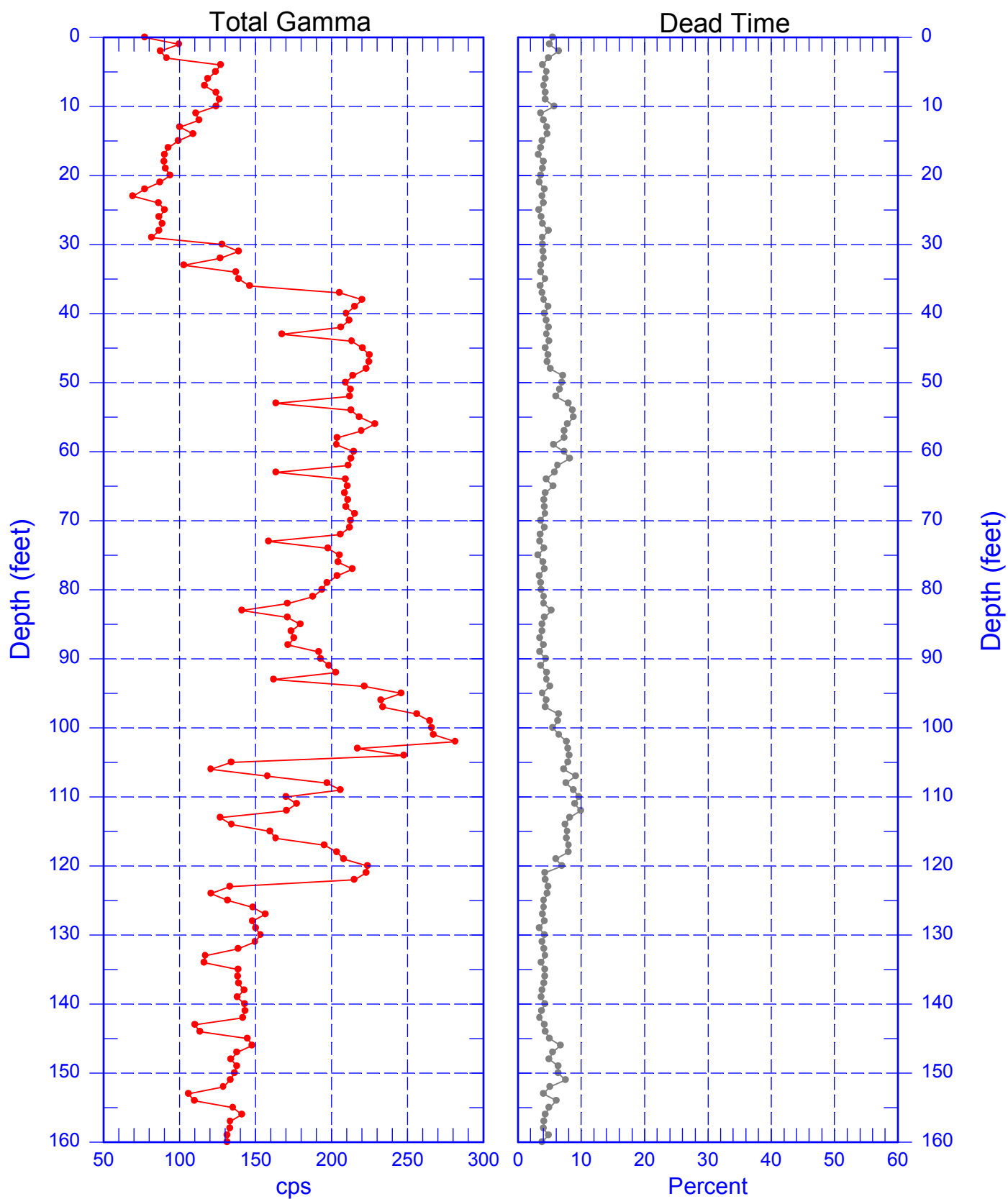
# 299-W14-19 (C3957)

## Rerun of Natural Gamma Logs (160.0 to 126.0 ft)



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## Total Gamma & Dead Time

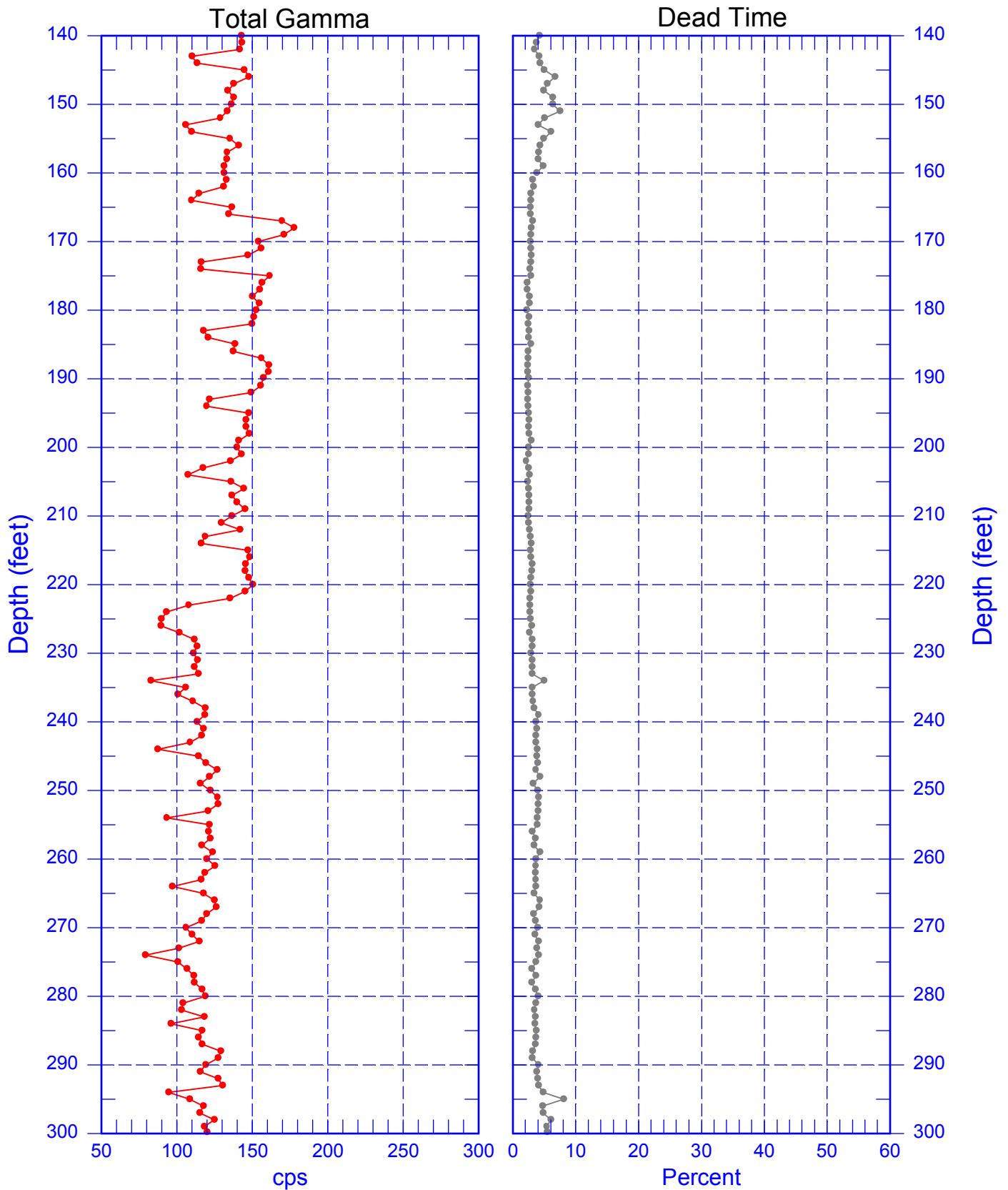


Zero Reference = Ground Surface

Date of Last Logging Run  
10/30/2002

# 299-W14-19 (C3957)

## Total Gamma & Dead Time

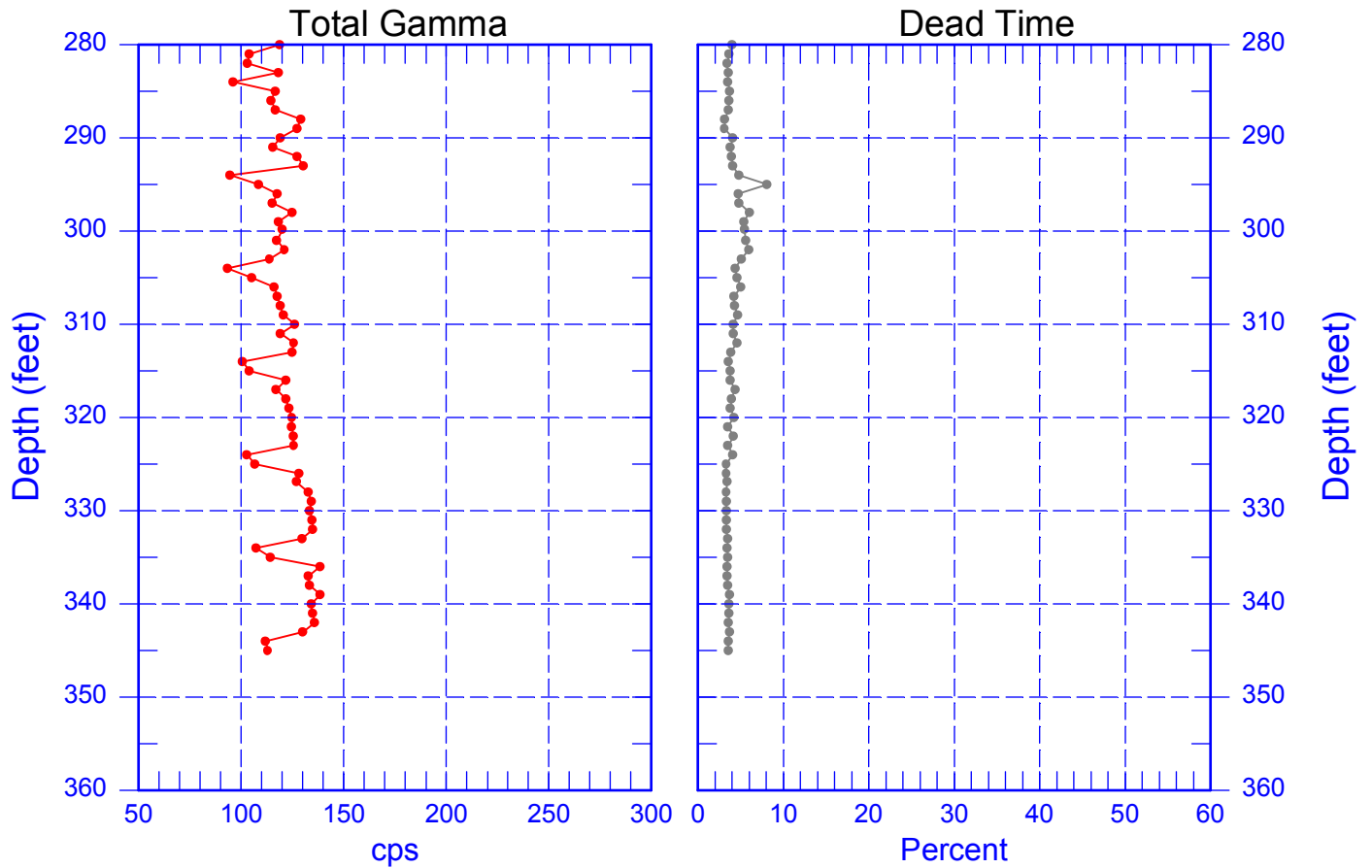


Zero Reference = Ground Surface

Date of Last Logging Run  
10/30/2002

# 299-W14-19 (C3957)

## Total Gamma & Dead Time



Zero Reference = Ground Surface

Date of Last Logging Run  
10/30/2002